



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/728,706	12/05/2003	Kang-Hyun Lee	OPP 031367 US	9971
36872	7590	03/31/2006	EXAMINER	
THE LAW OFFICES OF ANDREW D. FORTNEY, PH.D., P.C. 7257 N. MAPLE AVENUE BLDG. D, SUITE 107 FRESNO, CA 93720			NGUYEN, TUAN H	
			ART UNIT	PAPER NUMBER
			2813	

DATE MAILED: 03/31/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/728,706	Applicant(s) LEE, KANG-HYUN	
	Examiner Tuan H. Nguyen	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 January 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-18 and 20-22 is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-18 and 20-22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 3, 4, 18, 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Background of the invention in view of Chung et al. (cited ref.).

Background of the invention, pages 1-2 discloses the conventional general metal line fabrication method including the steps of forming an insulation layer on a semiconductor substrate on which devices or lower lines are formed; and then forming an aluminum metal layer on the insulation layer (paragraph [0007]); forming a photoresist pattern having openings of certain width on the aluminum metal layer; and selectively removing the aluminum metal layer at a lower side of the openings by dry etching to form a plurality of metal lines (paragraph [0008]).

Background of the invention fails to teach the formation of buffer layer on the photoresist pattern, including in the openings, for protecting the photoresist pattern from etchant so that the thickness of photoresist pattern needs not to be increased in forming openings having a critical dimension of less than 0.23 micron (paragraphs [0010]-[0012]).

Chung et al., in a related method for reducing dimensions between patterns on a photoresist as shown in figs. 1-3 and text on col. 1-4, teaches the use of buffer layer

150 of oxide film of PE family (col. 3, last two paragraphs) on the photoresist pattern 130 for a subsequence of etching to form an opening having a width of less than 0.26 micron (i.e. 0.02 micron, col. 3, lines 44-46). The use of buffer layer would enhance the etching resistance of the photoresist pattern, allowing the photoresist layer having a lower thickness as required in the conventional method for forming opening having a critical dimension of less than 0.23 micron (col. 1, lines 5-40).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used buffer layer on the photoresist pattern as suggested by Chung et al. in the conventional process of forming metal line in the Background of the invention since it would enhance the etch resistance of the photoresist, increase the precision of patterning and defining of the photoresist, reducing the dimension of the opening, lower the photoresist thickness (col. 1, lines 22-40).

With respect to the thickness, it would have been obvious to those skilled in the art to recognize the photoresist thickness of less than 9000 angstroms is inherently required in forming opening of 0.02 micron with precision as disclosed by Chung et al.

It would also have been obvious to one having ordinary skill in the art at the time the invention was made to have selected a suitable thickness for photoresist layer and buffer layer as claimed in order to obtain the optimum result. The thickness ranges are considered to involve routine optimization.

Claims 2, 5-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Background of the invention in view of Chung et al. as applied to claims 1, 3, 18, 20-22 above, and further in view of Narita et al. (cited ref.).

The combination of Background of the invention and Chung et al. fails the teach the use of organic ARC between the metal layer and the photoresist pattern, and the metal layer comprises a lower metal layer of TiN/Ti as a barrier layer, an intermediate metal layer of Al-Cu alloy, and an upper metal layer of TiN/Ti as a capping layer.

Narita et al., in a related dry etching method as shown in figs. 15-22 and text on col. 9-14, teaches the formation of metal layer 13 including the lower metal layer 13d of TiN/Ti as an barrier layer (col. 11, first paragraph), intermediate metal layer of Al-Cu alloy 13a (col. 11, first paragraph), upper metal layer 13b of TiN/Ti (col. 8, fifth paragraph) on the insulating layer 12; forming an organic ARC layer 13c on the metal layer 13 (col. 12, lines 44-45); forming a photoresist pattern 17 having an opening of certain width on the metal layer 13 for a subsequent etching the metal layer 13 by dry etching using Cl_2/BCl_3 as an etching gas (col. 11, first paragraph) to form a plurality of metal lines (figs. 22A-22D).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have replaced aluminum metal layer with a stacked film for forming metal lines by dry etching method using Cl_2/BCl_3 as an etching gas as suggested by Narita et al. in the combination of Background of the invention and Chung et al. process for preventing metal from being side-etched.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Fang et al. teaches the use of buffer layer 26 on photoresist pattern 23 for improve the etch resistance of photoresist, prevent damage induce by etching process without increase the thickness of the pattern photoresist ([0019]; Peng discloses the use of polymer coating 24 on the photoresist pattern 20 having thickness of 7000 angstroms as a mask (see col. 5, tables I,II) for etching the underlying layer having opening of 0.37 micron wide; see also Babcock for a related process.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Response to Arguments


Applicant's arguments filed 1/12/06 and the Declaration filed 1/12/06 have been fully considered but they are not persuasive. Since the Background of the instant invention as well as in Chung et al.'s Background art encountered the same problems with photoresist layer thickness when etching metal lines having critical dimension of less than 0.23 micron (Background of the instant invention, paragraphs[0010]-[0012]; chung et al, col. 1, lines 19-40); however, Chung clearly suggests the method to enhance the etching resistance of the pattern photoresist layer by using a buffer layer over the pattern photoresist layer. This would eliminate the problems associated with the bad selectivity with the photoresist that would require increase in photoresist layer thickness to more than 9000 angstroms in etching metal line having a critical dimension of less than 0.23 micron. Contrary the Applicant's argument in his Remark, pages 7, last paragraph that "Chung appears to be silent with regard to any defect reduction effects of forming the layer of inorganic material over the pattern and defined photoresist layer." Of course, in Chung et al., when the metal lines are successfully patterned with precision based on the use of a masking of an organic layer over the photoresist pattern to enhance the etch resistance to the photoresist pattern, it implies there are no defects. This in combination with the Background of the invention or the conventional art would further address to the same problems of using thicker photoresist such as metal bridge or metal stringer phenomenon which is well-known. With the use of "buffer layer " as suggested by Chung et al., these problems would be inherently eliminated, the thickness of photoresist would not need to be increased, or would be reduced to less

than 9000 angstroms due to low resolution photolithography process, and due to the use of etch resistance buffer layer in etching metal lines having critical dimension of less than 0.23 micron as required in the current sub-micron technology.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tuan H. Nguyen whose telephone number is 571-272-1694. The examiner can normally be reached on 9AM-5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Tuan H. Nguyen
Primary Examiner
Art Unit 2813